MFED – Fuzzy edge detector

Ver.: 1.3

User manual

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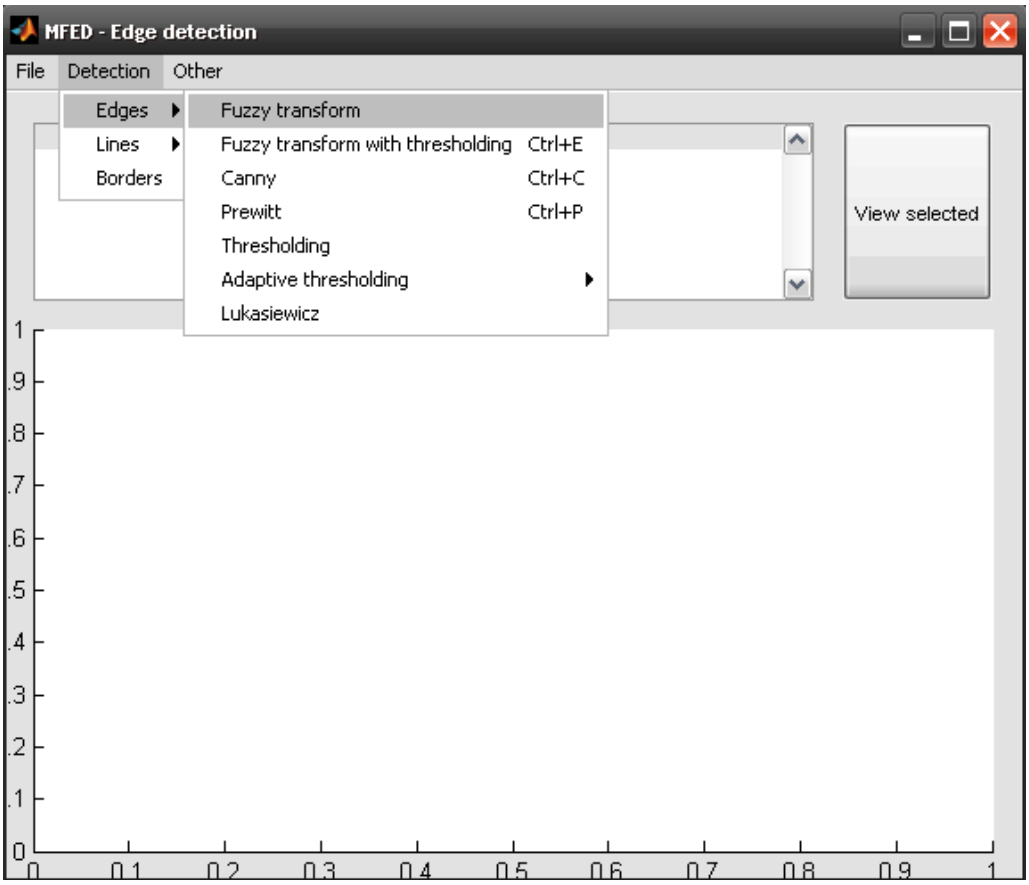
http://irafm.osu.cz



1 MFED – Fuzzy edge detector

MFED is Matlab implementation of edge detection algorithms, with extension of the behavior of the classical algorithms. Moreover, edge detection algorithms supported by the discrete fuzzy transformation are added. Those approaches use fuzzy transform described in [http://irafm.osu.cz/en/c94_image-processing/] to edge detection in the selected image. It profits from properties of fuzzy transform in the locations of color changes in the image and the behavior of created components for those locations.

The application takes the selected image and settings as an input and generates the resulting image containing detected edges as white places in black canvas, or where edges are marked in the black-white scale to expose how significant the edge is.

2 Instalation

The application is developed and tested only for Windows OS family. Tested and verified versions/editions are Windows XP Home/Professional and Windows 7 Professional.

To run the application the product called MATLAB Compiler Runtime (MCR). This package can be downloaded from the internet or can be provided on request by the IRAFM institute. More information can be found at http://www.mathworks.com/help/toolbox/compiler/f12-999353.html#bs5vv3i.

Second step is to install application. Distributed ZIP file needs to be extracted to some location. If MCR package is installed correctly, the extracted file ReadImages.exe must be executed to start the application.

3 Usage of the application

3.1 Step first – loading the file(s)

You can load or save the file using the menu *File* → *Open*. Application can accept common image file types, however, there have been reported some issues with PNG files. Unfortunately, this issue source is probably located in the original Matlab libraries and we have no way how to treat them. We suggest users to prefer .jpg or .bmp files.

Multiple files can be loaded at once, but only active one will be used (see below).

3.2 Step two – setting active file

You must select the *active file* from the list of the opened files. Select desired file in the list and push *View selected* button. The image will be displayed and become *active file*. Without no active file the application cannot proceed with detection.

There can be only one *active file* at the time.

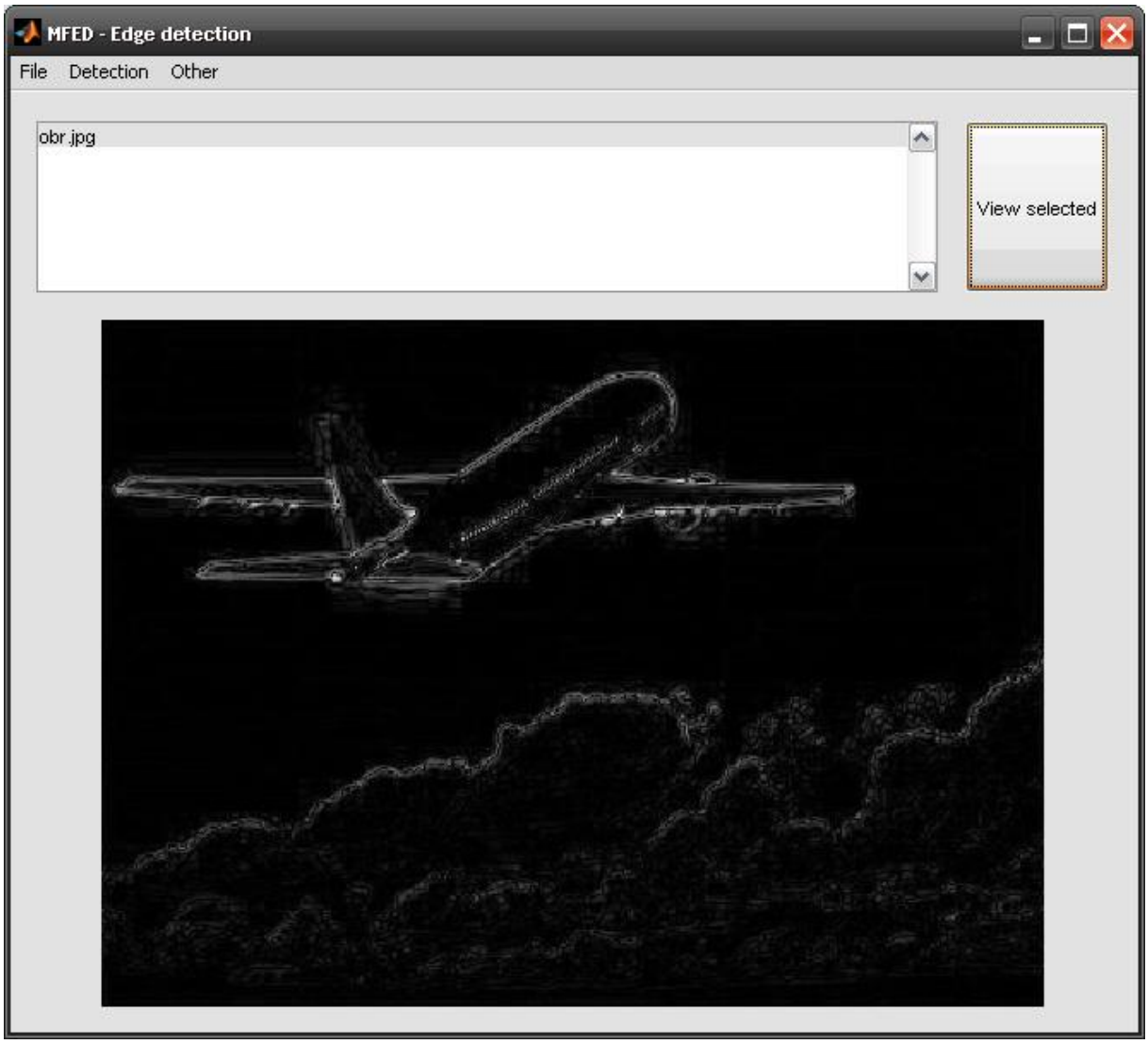
You can clear the list using *File* → *Clear list* menu item.

3.3 Step three - processing image

To process edge detection, select one of the methods in the *Detection* menu. There are multiple methods, the most interesting developed using fuzzy transformation or Lukasiewicz algebra are explained below. All can be found under *Edge* → *Detection* menu.

3.3.1 Fuzzy transform

Fuzzy transform this algorithm will process the input image using the two dimensional default fuzzy transformation with input image matrix as a source. Then, the result is combined with two one-dimensional fuzzy transformations, one by rows and the other by columns). More information about the principles of the edge detection using fuzzy transformation can be found at [http://irafm.osu.cz/en/c94_image-processing/].



The execution the method asks for *points-per-base*. This value defines the size of the basis function. The common value for most case are 3-5; higher value may improve results for noisy images, but produces more blurry edge detections.

3.3.2 Fuzzy transform with thresholding

This approach extends previous method with thresholding over the detected edges. The calculated edges are adjusted by threshold – that is value entered by user during the process. Finally, it joins together close-located thresholds.

3.3.3 Adaptive thresholding

Those methods uses classical thresholding approaches with floating window over the whole image. Again, size of the window and the other parameters of the methods can be entered in the dialogs during the process.

3.3.4 Lukasiewicz

Another implemented approach uses fuzzy transform over the standard Lukasiewicz algebra. This only approach is internally built for source ranges < 0; 1 >, so the source images have to be transformed into this range. There can be multiple approaches based on this technique. Implemented solution starts from the definition of two operations, marked as * and →. Definition of those operations follows:

$a * b = \inf\{(a + b - 1),(1)\}$

$a \rightarrow b = \sup\{(1 - a + b),(2)\}$

Using this approach, basis for the forward and inverse fuzzy transform can be made. There are two typical approaches dependent on the way how the meaning of the functions is mapped by the fuzzy transformation over Lukasiewicz algebra. The one described above produces a lower approximation of the input. There exists also the dual to this fuzzy transform that creates an upper approximation of the input. Since in the problem of image fusion, both approaches give nearly the same results, we have decided to implement only one of them. This approach can be used to extract sharp parts from the input set of images and provide them as a result.

This approach uses trapezoid basis function, so the algorithm asks via dialogs for two values – kernel size of the trapezoid (that means the rectangle part) and edge size (this built the trapezoid).

3.4 Step four – Saving the result files

Result file can be saved, again using *File* → *Save* menu item. You must provide extension of the file, because via extension the file-type format of the saved file can be recognized. BMP, JPG and PNG files are supported.

3.5 Other behavior

You can return to the previous image by menu *Other* → ← *previous image*.

4 Uninstallation

The program can be simply deleted from the computer.

The MCR have to be uninstalled via standard OS installation menu, that is *Control Panel* → *Add or remove programs*.

5 Other information

According to continuous research in this area, a newer version of this or similar software may be available. For any further information or comments contact IRAFM staff.

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